

ACCESSION #: 9907200054

NON-PUBLIC?: N

LICENSEE EVENT REPORT (LER)

FACILITY NAME: Waterford Steam Electric Station, Unit 3 PAGE: 1 OF 9

DOCKET NUMBER: 05000382

TITLE: Uncomplicated Automatic Reactor Trip Following Loss of
7KV Bus

EVENT DATE: 06/14/99 LER #: 99-006-00 REPORT DATE: 07/14/99

OTHER FACILITIES INVOLVED: N/A DOCKET NO: 05000

OPERATING MODE: 1 POWER LEVEL: 100

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR
SECTION:

50.73(a)(2)(iv)

LICENSEE CONTACT FOR THIS LER:

NAME: Emile Brauner, Engineering Superintendent TELEPHONE: (504)739-6630

COMPONENT FAILURE DESCRIPTION:

CAUSE: SYSTEM: COMPONENT: MANUFACTURER:

REPORTABLE EPIX:

SUPPLEMENTAL REPORT EXPECTED: NO

ABSTRACT:

On June 14, 1999, at 1307 hours, while at 100% power, Waterford 3 experienced an automatic reactor trip when the A1 7KV electrical bus was lost. An investigation of the event has determined the most probable cause of loss of the A1 7KV electrical bus and subsequent reactor trip to be a spurious actuation of a relay on either Reactor Coolant Pump 1A or 2A. Immediately following the trip, Operations personnel entered Emergency Entry Procedure, OP-902-000 and subsequently Uncomplicated Reactor Trip Recovery Plan Procedure, OP-902-001. The plant was stabilized in Mode 3, Hot Standby.

Various plant components were walked downed and tested to determine the root cause of the event.

Although the root cause of this event is indeterminate, the Reactor Protection System performed as designed. A low Departure from Nucleate Boiling Ratio (DNBR) trip was initiated due to decreasing speed of Reactor Coolant Pumps (RCPs) 1A and 2A, which was caused by the loss of the A1 7KV Bus. Required plant systems responded and the appropriate trip/actuation signals were generated. The health and safety of the general public were not compromised during this event.

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REPORTABLE OCCURRENCE

On June 14, 1999, the Reactor Protection System [JC] automatically actuated on a low DNBR initiated by decreasing speed of RCPs 1A and 2A. This occurrence resulted in a Reactor trip. Accordingly, this event is being reported pursuant to 10CFR50.73(a)(2)(iv) as an event that resulted in an automatic actuation of the Reactor Protection System. On June 14, 1999, a one hour notification was made per 10CFR50.72(A)(2)(iv) requirement.

INITIAL CONDITIONS

Prior to this event Waterford 3 was at 100% power. There were no system, structures, or components inoperable relative to this occurrence.

EVENT DESCRIPTION

The Waterford 3 plant receives electrical power either from the Main Turbine Generator [TB-GEN] via the Unit Auxiliary Transformers (UATs) or from the offsite electrical grid via the Startup Transformers (SUTs).

(Refer to Figure 1: Simple Electrical Distribution System Drawing) The 6.9 KV (7KV) Electrical Distribution System originates at the secondaries of the UATs and SUTs and extend to two non-Class 1E switchgear, A1 and B1.

The 7 KV switchgear provide power for operation and control of the following large, non-safety related motors:

- o Four Reactor Coolant Pumps (RCPs) [AB-P]
- o Four Circulating Water Pumps (CWPs) [NN-P]
- o Three Condensate Pumps (CDPs) [SD-P]
- o One Auxiliary Feedwater Pump (AFWP) [SJ-P]

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In the event electrical power is lost to either the A1 or B1 7 KV switchgear, a reactor trip occurs following low RCP [AB-P] speed.

On June 14, 1999, Waterford 3 was operating at 100% power. The Emergency Diesel Generator (EDG) A [EK-DG] was running and loaded on the A3 4.16 KV bus for surveillance testing. DNBR and Local Power Density (LPD) channel A were in bypass to support excore nuclear instrumentation troubleshooting in accordance with Maintenance Action Item (MAI)-405888. At approximately 1307 hours on June 14, 1999, an automatic reactor trip occurred. The reactor trip was initiated by the 3 remaining non-bypassed channels on low DNBR (2 of 3 required to trip). These trips are initiated by the Core Protection Calculators (CPC) [JC] Channels when Reactor Coolant Pump (RCP) speed is less than or equal to 96.5% of rated RCP speed. This causes DNBR to be reduced to a tenth of its original value. The low DNBR trips occurred due to decreasing Reactor Coolant Pump 1A and 2A speed caused by the loss of the 7KV A1 bus which supplies power to the RCPs. A generator [TB-GEN] trip was in turn initiated by the 86G1 and 86G2 relays.

CAUSAL FACTORS

Following the reactor trip, a Significant Event Review Team (SERT) was established to determine the cause of the event. Several possible causes were reviewed as provided below:

- o Plant conditions prior to the trip were reviewed to determine applicability to the trip. EDG "A" was running and loaded per procedure OP-903-068, "Diesel Generator and Subgroup Relay Operability Verification". The EDG was connected to the 4160 Volt bus which is electrically isolated from the 7KV bus. The EDG was running to satisfy a 28-day interval surveillance test.

There were no

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indications of any anomalies relating to the EDG run.

Plant maintenance instrumentation technicians were performing maintenance in the "A" Plant Protection System (PPS) [JC] cabinet. Troubleshooting was being performed on the log Nuclear Instrumentation (NI) channel. PPS channel "A" was in bypass and the CPC trips were toggling as expected, as work was being performed. The technicians and PPS system engineer were interviewed to determine if any activity in this cabinet could have initiated the plant trip. It was determined there is sufficient separation between channels such that working in the "A" cabinet could not have affected the "B", "C" and "D" channels

simultaneously. Additionally, a printout of the CPC buffer was reviewed. This indicated that the plant tripped on an "anticipatory trip" of RCP speed less than or equal to 96.5%. This is consistent with a loss of the A1 bus prior to a reactor trip.

- o Sub-station personnel were performing maintenance on the switch yard batteries. These batteries provide power to the switch yard protective circuitry. The batteries were on equalize charge (elevated voltage). There is no electrical link between the switchyard battery circuit and the plant.

- o A report was received indicating plant personnel may have been cleaning an overhead cable tray in the Turbine Building +40 elevation at the time of the plant trip. These personnel along with their supervisor were interviewed. It was determined the individuals were not in the vicinity of cable tray during the reactor trip.

- o Operations personnel were interviewed for activities being performed immediately prior to the event and immediately after the event. There were no activities being performed prior to the event that could have initiated a loss of the A1 bus. There were no DC grounds identified on the bus for the past day. There were no personnel known to be in the area surrounding the A1 switchgear. First responders to the event were interviewed and

it was determined that no electrical protective relay "flags" were reset prior to SERT team activation.

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o The SERT team investigated a condensate leak which was near Condensate Pump "C" whose motor [SID-P-MO] is fed from the A1 bus. The leak was allowing water to flow onto the pump motor cooling duct. SERT team members walked this area down and no anomalies were found which would adversely affect plant operations. In addition, subsequent motor testing indicated this was not a cause of the trip.

o Arkansas Nuclear One (ANO) was contacted regarding a failure of RCP surge capacitors at their plant. ANO noted typical surge capacitor failure would initiate electrical noise on surrounding instrumentation. There was no indication of electrical noise generation prior to the plant trip. Additionally, the RCP motors were meggered and conductivity tested with satisfactory results.

o The Circulating Water Pumps, Condensate Pumps, and Switchgear bus were also tested. Conductivity and megger readings were satisfactory.

o Oil analysis was performed on the UAT. The results were satisfactory and there were no indications that an internal fault had occurred.

The SUT was not tested since it was not connected to the bus at the time of the trip.

o Identified RCP vibration anomalies were investigated by knowledgeable vibration personnel and determined to be a result of the trip, not a

cause of the trip.

- o A grid voltage drop of approximately 2KV occurred about 7 minutes prior to the plant trip. The plant responded with a corresponding increase in VAR production. The VAR increase occurred with a single 25 MVAR step increase and subsequently increased 45 MVAR over 4 minutes. Review of other generator responses indicates this is a normal and expected response.

- o The only indication of bus trip initiation was the UAT 74/HR relay. This relay has 5 trip inputs. These include the 3 bus overcurrent relays and the 2 RCP secondary containment penetration protection "2" Agastat relays. The 74/HR relay was checked for calibration. While this relay was

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outside of its calibration range, this could not have contributed to the trip. The relay was replaced. The 3 overcurrent relays were tested and found within calibration. These relays are flagged to indicate actuation. The flags worked as expected during calibration, however, no flags were found after the plant trip which indicates that these relays did not actuate. The "2" relay circuits were troubleshot.

- o A previous similar occurrence documented in corrective action document CR-WF3-1993-133 was reviewed which documented a spurious actuation of a similar "2" relay circuit during maintenance. It was determined

that lifting a lead during maintenance in the trip path caused the "2" relay to actuate. There was no relevant maintenance in process immediately prior to the June 14, 1999 reactor trip. In addition, as found "2" relay pick up voltage was checked along with normal circuit voltage across the coil. All indications were normal. A point to point wiring check was performed. Ammeters were placed in the circuit to ensure expected currents were present. All indications were normal.

o The Agastat relays' past maintenance history was researched. The relays were calibrated during the first quarter of 1999 in Refuel 09, with one relay being replaced. The "2" relays are time delay pick up relays and must be energized for 3.5 to 4.5 seconds to actuate the 74/HR relay on the A1 bus. Spurious actuation (coil energization or inadvertent contact chatter) is not a typical failure mechanism for Agastat relays. Typically Agastat Relays fail timing tests, they do not self-actuate.

After performing the above investigations, the root cause of this event could not be determined. Although, actuation of the "2" relay could not be confirmed, it is the only unmonitored input to the UAT 74/HR relay.

Therefore it was concluded the most probable single failure cause is a spurious actuation of a "2" relay from RCP 1A or 2A. By design, once the "2" relay actuates, a loss of the 7 KV

Electrical Bus occurs which causes the loss of the RCPs. A reactor trip then occurs due to low RCP speed.

CORRECTIVE ACTIONS

Immediately prior to reenergization of the A1 switchgear, SERT members performed a final switchgear walkdown with all indications normal.

SERT Team members and electricians monitored the "2" relay circuit for actuation. The bus was energized, but initially, not loaded. Bus voltages were checked and were confirmed normal. A walkdown indicated the switchgear was normal. The Condensate Pumps and Circulating Water Pumps were cycled on and off independently. With each load on the bus, bus voltage and current were measured. Walkdowns were also performed. All indications continued to be normal.

A configuration change was designed and implemented to provide monitoring of the "2" relay by the Plant Monitoring Computer sequence of events points.

Each RCP was started and allowed to run. (Cycling of the RCP was not performed because there was concerns for pump seals by both Engineering and Operations). Again bus voltages and currents were checked and were normal.

Finally all loads were started and allowed to run. Fully loaded bus voltage and currents were rechecked. All indicated normal. The "2" relay circuit did not actuate through this process.

Troubleshooting equipment was removed and the switchgear released to Operations.

SAFETY SIGNIFICANCE

This event caused a direct challenge to the Reactor Protection System by causing a loss of the Reactor Coolant Pumps and all Circulating Water Pumps while at 100% Reactor Power.

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Although the root cause of this event is indeterminate, the Reactor Protection System performed as designed. A DNBR trip was initiated due to decreasing speed of Reactor Coolant Pumps 1A and 2A, which was caused by the loss of the A1 7KV Bus. Required plant systems responded and the appropriate trip/actuation signals were generated. The plant was maintained throughout this event such that the health and safety of the general public were not compromised.

SIMILAR EVENTS

None

ADDITIONAL INFORMATION

Energy Industry Identification System (EIIS) codes are identified in the text within brackets [].

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Figure 1 "Simplified Electrical Distribution System" omitted.

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Early C. Ewing, III

Director Nuclear Safety & Regulatory Affairs

Waterford 3

W3F1-99-0121

A4.05

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July 14, 1999

U.S. Nuclear Regulatory Commission

Attn: Document Control Desk

Washington, D.C. 20555

Subject: Waterford 3 SES

Docket No. 50-382

License No. NPF-38

Reporting of Licensee Event Report

Gentlemen:

Attached is Licensee Event Report (LER) 99-006-00 for Waterford Steam Electric Station Unit 3. This report provides details of an Uncomplicated Reactor Trip.

This condition is being reported pursuant to 10 CFR50.73 (a)(2)(iv). This letter does not contain any commitments.

Very truly yours,

E.C. Ewing

Director,

Nuclear Safety & Regulatory Affairs

ECE/GCS/ssf

cc: E.W. Merschoff (NRC Region IV), C.P. Patel (NRC-NRR),

A.L. Garibaldi, P. Lewis - INPO Records Center,

J. Smith, N.S. Reynolds, NRC Resident Inspectors Office,

Administrator - LRPD

*** END OF DOCUMENT ***
